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BEYOND EA FRAMEWORKS: TOWARDS AN UNDERSTANDING OF THE ADOPTION OF ENTERPRISE ARCHITECTURE MANAGEMENT

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Abstract

Despite the increasing popularity of enterprise architecture management (EAM) in practice, many EAM initiatives either do not fully meet the expected targets or fail. EAM frameworks have been suggested as guidelines to EAM implementation, but our experience indicates that very few companies follow the steps prescribed by such frameworks. Motivated by the diverse approaches that we have observed in practice, our research strives for a broader understanding of how companies adopt EAM in their organizations. We address two questions: (1) Which approaches do companies take in adopting EAM? (2) What factors influence EAM adoption? To answer these questions, we developed an analysis framework to conceptualize EAM adoption and its contextual factors. Based on a set of eight case studies, we explore situational EAM designs and derive four EAM archetypes, which illustrate very diverse EAM adoption approaches in different situations. Our research helps broaden knowledge of EAM adoption by considering multi-dimensional and context-dependent EAM designs. It thereby relativizes the importance of frameworks and modeling, which we find over-emphasized in existing EA research. Our findings also offer starting points for prescriptive EAM research, supporting the successful introduction of EAM in organizations by taking contingencies into account.

Keywords: Enterprise architecture management (EAM), adoption, contingency factors, case study

1 Introduction

Enterprise architecture management (EAM) is an ever-evolving research field that has been approached from various perspectives for more than two decades. In 1987, Zachman introduced the Information Systems Architecture Framework, which is commonly accepted as the first approach to the EA discipline. In the early 1990s, EA evolved as a discipline and EA frameworks were created for specific industries, notably the public sector and defense industry. Since then, EAM has drawn considerable attention, both from academia and industry (Stelzer, 2010; Niemi, 2007; Radeke, 2010) and has become a widely accepted business-IT alignment approach. While there are many EAM frameworks and methods, companies still struggle to successfully adopt EAM (Roeleven & Broer, 2009; Schmidt & Buxmann, 2010; Morganwalp & Sage, 2004).

Our research is motivated by our practical experience, which shows that companies apply very diverse approaches in adopting EAM, and seldom follow the steps prescribed by EAM frameworks or methodologies. To date, EAM adoption has not been the focus of EA research, and a thorough understanding of *implementation approaches* and *context* is lacking (Radeke, 2010; Langenberg & Wegmann, 2004). Our overall research goal is to broaden knowledge of how companies adopt EAM. Using an explorative research approach, this study seeks to answer two primary questions: (1) Which approaches do companies take in adopting EAM – and how does EAM adoption differ from what is prescribed by existing EAM frameworks and the literature? (2) What factors influence EAM adoption? Hjort-Madsen (2007) describes EA adoption as "an emergent, evolving, embedded, fragmented, and provisional social production that is shaped as much by cultural and structural forces in the organizational context." It therefore deals with implementing EAM in different *organizational contexts*. When adopting EAM, companies must institutionalize EAM in their organizations (Schmidt & Buxmann, 2010). They must design their organizations to explicitly manage the EA life-cycle, conceptualize and document the EA in the form of models, and introduce new governance regimes. This is what we will call "EAM design," following Aier et al. (2011) and Winter (2011). In this paper, we develop an exhaustive set of dimensions to conceptualize these EAM designs. Addressing four critical case studies, we analyze differences and commonalities in order to derive different EAM design archetypes.

The remainder of this paper is structured as follows. First, we describe the research gap: We start by identifying evolutionary and contingency perspectives as the two main ones in investigating EAM adpotion, and go on to review state-of-the-arts in situational EAM adoption. The subsequent section focuses on our qualitative research method for data collection and analysis. Afterwards, an analysis framework by which EAM adoption could be characterized is presented. Then, we introduce four cases that we consider representative of very diverse approaches to EAM adoption, and analyze them based on the presented analysis framework. The paper is concluded by the explored taxonomy of EAM designs ("archetypes").

2 Prior work: Evolutionary vs contingency (situational) perspective

State-of-the-art reviews have found that EAM work focuses too much on frameworks and methods, and too little on implementation *approaches* and *context* (Radeke, 2010; Langenberg & Wegmann, 2004). To date, EAM adoption has primarily been examined by two different perspectives, namely the evolutionary perspective and the contingency perspective (Teo & King, 1997). The evolutionary perspective describes a *single path* for EAM adoption and is often associated with clear maturity levels. The contingency perspective argues that there is *no best way* to adopt EAM, but that adoption depends on different contingency factors.

2.1 Evolutionary perspective

The evolutionary approach is very common in IS research, particularly in EAM. It postulates stepped, progressive EAM implementation and is reflected by well-established *EAM frameworks*, such as TOGAF, DoDAF, etc. These frameworks define dedicated phases, which are often centered on the EA life-cycle. The evolutionary approach implies that clear maturity levels for EAM adoption can be distinguished, and inspired the development of *EAM maturity models* (Venkatesh et al., 2007). In order to support EAM adoption, *EAM patterns* have been developed as a "general, reusable solution to a common problem" (Buckl et al., 2007; Buckl et al., 2009; Ernst, 2008; Hjort-Madsen, 2007; Schulman, 2004). They comprise "a conceptual information model, viewpoints and methodologies for using the respective [EA] information" (Buckl et al., 2007). However, the evolutionary perspective has been criticized for its limited potential for explaining complex organizational phenomena (Teo & King, 1997), and evolutionary approaches ignore the contexts in which EAM must be embedded and used.

2.2 Contingency (situational) perspective

Prior research has highlighted the relevance of situational aspects in adopting EAM and has explained them by the underlying concept of contingency theory (Hersey et al., 2008; Fielder, 2005; Vroom & Jago, 1988). Table 1 illustrates the recent application of the contingency theory in EAM literature. Riege and Aier (2009) specify the EAM realization approach based on the EA sophistication level. However, their result is a classification of EA deployment maturity in organizations. Furthermore, they only concentrate on EA *method engineering* (Leppänen et al., 2007), i.e. the required actions to develop, customize, and configure a method to fit an organization's needs. Leppänen et al. (2007) also develop an EA contingency framework for method engineering, but do not propose pertinent EA methods to different sets of contingencies. Aier et al. (2011) as well as Winter (2011) reveal eight design factors that led to the definition of three different EAM designs. They follow a process-oriented approach to define EAM designs, whereas they claim to take advantage of situational theory to define a set of alternative designs, supporting the idea that one size does not fit all. In their design theory nexus for situational EA management, Buckl et al. (2010) also propose a model that would help enterprises choose the EAM approach that is best suited for their specific situation. They conclude with a situational method engineering construction process, but do not identify any types of EAM design associated with specific sets of situational factors.

Source	Contingency factors	Subject of investigation	Findings / Implications
Riege & Aier, 2009	Adoption of advanced architectural design paradigms and modeling capabilities, organizational penetration of EA	EA realization approach	Three levels of EA realization: EA engineers, IT architects, EA initiators
Leppänen et al., 2007	Cluster, role, resource, EA method goal, EA management, EA principle, EA method	EA method engineering	EA contingency framework
Aier et al., 2011; Winter, 2011	IT operation support, enterprise focus and management support, EAM governance, IT strategy and IT governance support, information supply, integrative role, design impact, business strategy support	EAM design	Three EAM designs: balanced (active), business-oriented, IT-oriented (passive)
Buckl et al., 2010	-	EAM approach	Design theory nexus

Table 1. The recent implications of contingency theory in EAM

In short, although some researchers have sought to take advantage of the concept of contingency theory, they generally end up with a fairly process-oriented and evolutionary proposition for EAM adoption. Furthermore, those publications that examine contingency factors mostly use EAM-related contingency factors. Given that EAM adoption requires context-dependent governance mechanisms (Boh & Yellin, 2006) as well as processes (Schmidt & Buxmann, 2010) to be in place, more research is needed to explore the organizational and institutional context affecting EAM adoption.

3 Research method

Case studies are well suited for studying EAM adoption in practice, since they allow for investigating a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are unclear (Yin, 2003, p.13). We opted for the *exploratory case study* method for understanding the dynamics present within single settings (Eisenhardt, 1989). Multiple cases were studied, because the knowledge gained from replicated case studies allows within-case and cross-case analysis and increases the findings' external validity (Yin, 2003, p.34). We initially selected eight cases by following a *theoretical* replication logic (Yin, 2003, p.47). According to this logic, cases must be selected based on their commonalities and differences to predict contrasting results and to allow researchers to extract generalizable patterns. We specifically investigated companies with different organizational designs (i.e. organizational and management structure) in different industries (i.e. manufacturing and services sectors) and with diverging EAM approaches, making use of our analysis framework as presented in the subsequent section. We chose four cases out of the larger dataset of eight cases for an in-depth analysis as these four cases were considered to be different extremes of EAM adoption (critical cases). Looking at different extremes enabled us understanding the spectrum of diverse EAM approaches and allowed us to identify their driving forces, situational factors and outcomes.

Data was gathered between June 2009 and February 2010 by means of semi-structured interviews and complemented by document analysis. Each interview was held by two researchers and lasted up to 150 minutes. The interviews were recorded and transcribed. Transcripts and collected documents were used to elaborate comprehensive case write-ups in order to summarize the empirical data into a consistent whole, become familiar with each case as stand-alone entity, enable unique case patterns to emerge, and to accelerate the cross-case comparison (Eisenhardt, 1989). The case write-ups were 20 to 25 pages long and were sent to the case organizations for review. Data analysis started with the coding of the final case write-ups according to the analysis framework (see Section 4). During the within-case analysis (Eisenhardt, 1989), we analyzed the codes related to EAM dimensions and contingencies for the single cases. The cross-case analysis implied a detailed search for the similarities and differences between the cases.

4 Analysis framework

Based on EAM literature, we derive an analysis framework for describing how a company adopts EAM as well as factors surrounding EAM adoption. The following section describes the analytical framework and its constituents.

4.1 Dimensions of EAM design

EAM adoption requires EAM institutionalization in the company's organizational context (Schmidt & Buxmann, 2010; Buckl et al., 2010). It can therefore be considered a specific organizational design and implies changes in three main dimensions (Figure 1): 1) the explicit management of the EA life-cycle (EA phases), 2) the conceptualization and documentation of the EA in the form of models (EA model and documentation), and 3) the introduction of new governance regimes (EA governance).

EA phases: Existing EAM frameworks and the literature describe typical EA life-cycle phases, such as extracting and assessing the baseline (as-is) architecture, defining the architecture vision, and describing the target (to-be) architecture. The latter works as a basis for the IT decision-making process and documents the migration plan for migrating from the baseline architecture to the target architecture. It also consists of EAM implementation, which refers to the execution of defined IT projects in order to reach the target architecture and accelerate the attainment of desired outcomes (Armour et al., 1999; Open Group, 2009).

EA model and documentation: This dimension refers to EA models that document the baseline architecture and the target architecture on different architectural layers and levels. EA models comprise business, process, system, and technology layers, and outline the major dependencies between them (Winter & Fischer, 2006; Pulkkinen, 2006; Iyer & Gottlieb, 2004; Wegmann et al., 2007). The architectural levels represent the scope in documenting different architectural layers, namely enterprise, domain, and system levels (Pulkkinen, 2006). Ideally, all architectural layers and levels are documented based on a shared meta-model and stored in an integrated repository. An EA repository can support different methodologies and modeling approaches (Schekkerman, 2006, p.202).

EA governance: Recent studies have emphasized the importance of formalizing EAM procedures in corporate governance (Boh & Yellin, 2006; Schmidt & Buxmann, 2010; Riege & Aier, 2009; Iyer & Gottlieb, 2004; Winter & Schelp, 2008). A centralized governance structure is required to ensure concordance of different architectural layers and to oversee EAM quality (Boh & Yellin, 2006; Radeke, 2011). The EA governance dimension consists of four sub-dimensions (Boh & Yellin, 2006): (1) Organizations and roles with EAM responsibilities, such as EAM units, architect roles, and committees involving key EA stakeholders. (2) Standards and principles, comprising a set of policies, rules, and guidelines that shape unified logic across architectural layers. (3) Enforcement and control, i.e. formalized procedures that enforce EAM-related standards as well as maintenance and updating principles (Riege & Aier, 2009; Fischer et al., 2007). (4) Communication (Schmidt & Buxmann, 2010), i.e. the involvement and commitment of all EAM stakeholders, for instance, top management or a target group in business departments – a critical success factor for EAM endeavors.

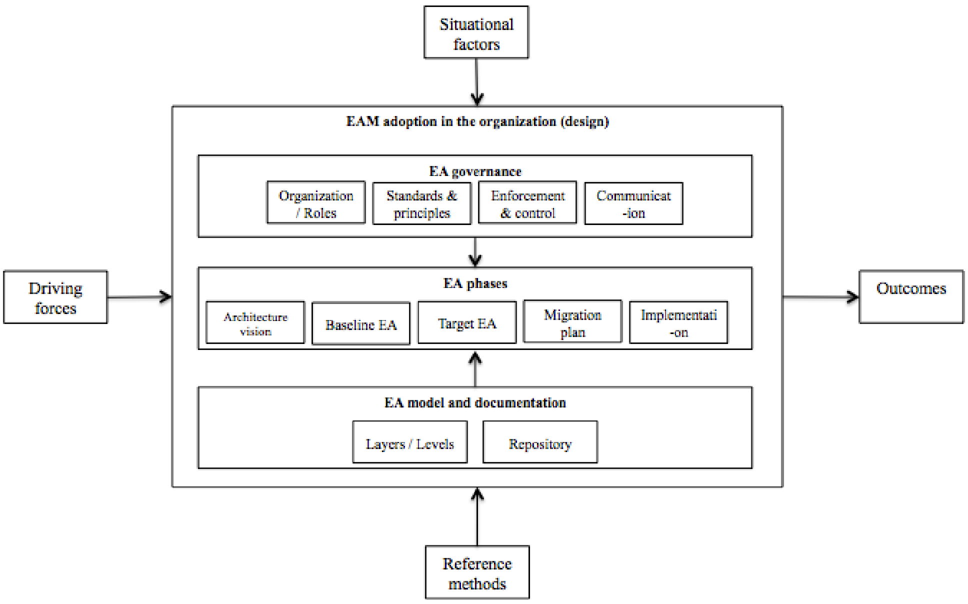

Figure 1. *EAM dimensions and their surrounding factors*

4.2 Situational factors, drivers and outcomes

We used a combined approach (Leppänen et al., 2007) to identify contingency factors, and extracted them deductively (from EAM literature as well as general studies on IS/IT management and adoption) and inductively (from case studies). Hence, the main contingency factors in EAM are as follows: (1) the *organizational structure* (Sambamurthy & Zmud, 1999; Fiedler et al., 1996; Sabherwal & King, 1995; Brown & Magill, 1994; Weill & Margrethe, 1989) that has three primary modes of corporate governance: centralized, decentralized, and federated structures; (2) *IT management structure*, which is often a function of the organizational structure (see Fiedler et al., 1996; Sabherwal & King, 1992) and has similar modes, i.e. centralized, decentralized, and federated (Fiedler et al., 1996; Brown &

Magill, 1994); (3) *size* (Sambamurthy & Zmud, 1999; Sabherwal & King, 1995; Brown & Magill, 1994; Premkumar & King, 1994; Weill & Margrethe, 1989); (4) *type of business and industry* (Premkumar & King, 1994; Brown & Magill, 1994); and (5*) IT penetration* (Sambamurthy & Zmud, 1999; Sabherwal & King, 1995; Teo & King, 1997; Brown & Magill, 1994; Premkumar & King, 1994), which considers the technical and managerial IT infrastructure in the organization.

Regarding EAM drivers and outcomes, the analysis framework builds on EAM literature: *business-IT alignment* (Kappelman et al., 2008; Schöenherr, 2009; Lange & Mendling, 2011; Radeke, 2011), *application and data integration/interoperability* (Boh & Yellin, 2006; Kappelman et al., 2008), *IT efficiency* (Schmidt & Buxmann, 2010; Kappelman et al., 2008), *IT flexibility* (Schmidt & Buxmann, 2010; Lange & Mendling, 2011), *cost reduction* (Schöenherr, 2009; Lange & Mendling, 2011), *consolidation/standardization* (Boh & Yellin, 2006; Schöenherr, 2009; Radeke, 2011), and *modularization* (Radeke, 2011).

Furthermore, we argue that the EAM design will most likely be dependent on reference methods, which companies use as a basis for deriving EA phases and documentation, such as *EA frameworks*, *reference architectures* for different architectural layers, and *vendor-specific methodologies*.

5 EAM adoption in four case studies

In this section, we present our within-case and cross-case analyses of four critical case studies, which we consider extremes of EAM adoption (critical cases) representing different EAM designs.

5.1 Case overviews

Company A is one of the world's largest automobile manufacturers. In 2009, its sales amounted to 105.2 billion EUR (a market share of 11.3 percent); in that year, it employed 368,500 people in 21 countries. It consists of nine brands and utilizes a decentralized and product-based organizational structure. On the IT side, the company takes advantage of the matrix organization approach, i.e. it is decentralized at the brand level but implements global coordination by a centralized IT department. The main driving forces of EAM efforts are standardization and modularization. The company does not apply any specific EA framework, reference architecture, or vendor methodology. Given the company's size, EAM efforts concentrate on harmonizing business applications, developing technical standards, and ensuring that those standards are applied throughout the organization.

Company B is one of the world's largest nutrition, health, and wellness manufacturing companies, and is represented in more than 80 countries. In 2009, the company's sales amounted to 108 billion CHF, a net profit of 10.4 billion CHF was posted, and employees totaled 280,000. It has a centralized organizational structure; all business divisions are based on geographic zones. On the IT side, it takes advantage of enterprise-wide IT/IS management, which has been followed by a program to centralize and standardize all IT applications. The shared business processes, standardization, and global IT management shape the main drivers of EAM. Accordingly, EAM efforts are organized to implement the SAP ERP system throughout the company. Regarding reference methods, the EAM efforts are structured based on the SAP implementation method and business process reference architecture.

Company C is an internationally decentralized (four fairly independent brands) company. Well known in the retail industry, it employed 286,091 people in 2009, with sales of 65 billion EUR. On the IT side, the company takes advantage of a federated and fairly decentralized structure, by means of two cross-divisional service companies. The company plans to utilize a fully federated and decentralized approach in 2012. The main motivations for EAM efforts are based on its current situation in terms of IT implications, which are: a heterogeneous infrastructure and application landscape, a lack of holistic overviews, the need to better align IT systems with the business processes, and running IT systems in several releases. The company strictly adheres to the ARIS framework and takes advantage of application reference architectures, which comprise software modules and frameworks as well as descriptions of how and when to apply them.

Company D is a global financial services company that, in 2009, employed 77,053 people and had revenue of 28 billion EUR. It is organized into three centralized group divisions, which are further subdivided into corporate divisions. The company's centralized IT organization serves both the private banking and investment banking departments. The company does not explicitly follow any internal or external frameworks for EAM. The overall direction is business-oriented and is aimed at setting up the general architecture based on business processes and a service-oriented architecture (SOA). EAM efforts are structured according to SOA initiatives to reduce complexity and increase the reuse of functionality across business units.

5.2 Cross-case analysis

Table 2 compares the four cases based on the analysis framework. It summarizes EAM dimensions and explores the relationship between EAM designs and their associated contingencies.

EA phases: All companies started by documenting their baseline architecture, and subsequently defined at least some elements of their target architecture. Only Company C managed to do both in one phase. Interestingly, and in contrast to EAM frameworks, none of these companies dedicated a separate phase in EAM for migration, yet all of them worked on a migration plan in their target architecture phase. The implementation approach for target architecture is a function of architecture vision and the IT management structure (i.e. EA governance). For example, in Company B, EAM implementation is strongly dependent on a global ERP system, defined as architecture vision to establish shared business processes, and is promoted through centralized IT governance. In Company C, the vision is to reduce complexity and increase reusability by following an SOA approach.

EA models and documentation: The four companies took diverse approaches to EA modeling and documentation. Although all of them considered the main EA layers, their EA models have different foci and levels of abstraction. Company C documented all architectural layers in detail, following a defined EAM framework and meta-model. Company A only documented core business processes and applications in the abstract level for both the baseline architecture and the target architecture. Regarding EA levels, Company D documented EAM artifacts based on a domain architecture in order to manage the number, size, and complexity of IT projects resulting from the SOA approach. Different repositories have been used for different architectural layers (with the exception of Company D's central repository), but no meta-models were applied in modeling efforts (with the exception of Company C).

EA governance: EAM organization is dependent on the general IT management approach, which, in turn, is affected by the company's organizational structure. In all cases, the enforcement and control procedures build on top management support and target group involvement (communication with stakeholders) by means of: 1) gathering demands and requirements from business units, and 2) a set of governance/approval procedures for project portfolio management and system architecture (i.e. defining functional and technical specifications). Defining a set of standards and principles is a core EAM activity, but the way they are created and enforced as well as the types of standards and principles differ widely as well as. While Company D focuses on service-oriented standards and Company A emphasizes IT infrastructure technologies and products, Company B imposes standards that relate to its enterprise-wide core application.

EAM outcomes: The common outcomes of EAM efforts are consolidation and standardization, cost reduction, as well as application and data integration. The pain points depend on the EAM adoption approach, but the most common ones concern the time-consuming process of standardization as well as resistance to change by EAM project members and the target group (business side).

Table 2. EAM dimensions in each case

Analysis dimensions	Sub-dimensions	Company A	Company B	Company C	Company D
EA governance	Organization/ Role	▪ A dedicated board is in charge of EAM-related decisions ▪ IT landscape planners, master architects, architects, and chief architect	▪ No dedicated board ▪ Centralized IT governance	▪ No dedicated board ▪ Structured based on two service companies	▪ Two boards in charge of EA-related decisions ▪ The domain architects, solution architects, business analysts, technical specialists and project leaders
	Standards and principles	▪ Defining standards as one of the main EAM activities ▪ Business application standards as well as technological standards i.e. a Book of Standards and Handbook for Systems Design	▪ Physical infrastructure standards	▪ Physical infrastructure, human resources, integrating business applications, and enterprise data architecture standards	▪ service-oriented standards
	Enforcement and control	▪ Gathering the demands and requirements from the business side and running projects ▪ Approval process of software architectures and the standardization of IT components	▪ The demand management process ▪ The project portfolio management process ▪ The project life-cycle process ▪ Maintaining core applications ▪ Addressing emerging technologies	▪ Addressing incoming demands in order to set functional specifications ▪ Developing the technical specifications (detailed software architecture) ▪ Application portfolio management process	▪ Portfolio management in which domain architects document costs, risks and goals of a bundle of projects ▪ Implementation in which solution architects give design and programming guidelines
	Communicat-ion	▪ Target group involvement ▪ Top management support	▪ Target group involvement ▪ Top management support	▪ No evidence	▪ Target group involvement ▪ Top management support
EA phases	Architecture vision	▪ Standardization and modularization	▪ Establishing a shared business process architecture ▪ Standardized data ▪ Standardize IS/IT worldwide	▪ IT landscape harmonization ▪ Readiness for future changes in IT artifacts	▪ Reduce complexity ▪ Reusability
	Baseline architecture	▪ Identifying application redundancies ▪ Gathering the demands and requirements from the business side	▪ Modeling processes, applications and date exchanges	▪ No monitoring of the difference between the current status and the envisioned status	▪ Creating capability maps containing the current state, the target scope, and a defined technology stack behind it
	Target architecture	▪ Developing application standards ▪ Deciding on the first technical architectural design of the systems	▪ IT landscape planning based upon SAP system	▪ See as-is architecture	▪ IT strategy process
	Migration	▪ No dedicated activities and documents	▪ No dedicated activities and documents	▪ No dedicated activities and documents	▪ No dedicated activities and documents
	Implementat-ion	Concentrates on ▪ Reusable application services through IT module management ▪ Business-oriented SOA	▪ Based on SAP ERP system	▪ Based on a classification of applications to local, shared, and harmonized systems	▪ Affected by SOA approach
EA model and documentat-ion	Layers/ Levels	▪ Process, system and technology architectural layers in system and domain levels and documenting core business processes and applications in abstract level for as-is and to-be architecture	▪ Business, process and system layers	▪ Business, processes, data, system, IT integration, and IT infrastructure layers modeling the interfaces and the data exchange between applications	▪ Process, system and technology layers in baseline and target architecture
	Repository	▪ Different tools for different architectural layers and different units ▪ ProAMT, UML tools, Enterprise Architect, and a CMDB	▪ Different tools for different architectural layers and no common meta-model ▪ Ascendant repository, Nimbus Control, Nestool contains the core processes covered by the SAP ERP, as well as several smaller tools	▪ Two independent tools namely the enterprise governance tool (EGT) and IT governance tool (IGT) as well as a subset of the ARIS methodology serve as a meta-model	▪ Central repository as well as BPM tools ▪ SOA service repository, ADONIS BPM, and ADO IT

6 Findings: EAM archetypes

Based on our analysis framework, we identified similarities and differences between the EAM designs of these four cases. First and foremost, all four companies addressed the different dimensions of EAM designs outlined by the analysis framework. However, in spite of some similarities, we observed also significant differences between their approaches to EAM adoption. In the EA phases, based on their architecture vision, they followed different approaches to baseline and target architectures, which in turn affected EA implementation in later stages. EA phases are the first point of difference. Also, different types of EA standards (in EA governance) were developed according to their specific EAM approach. Finally, their EAM designs reflect the chosen reference methods. In one case, vendor methodology was aligned with the target architecture and implementation phases; and, in another case, the EA framework played a key role in documenting EA artifacts in the baseline and the target architecture. From the aforementioned differences, we conclude that companies may approach EAM in very different ways. Looking at different cases enabled us understanding the spectrum of diverse EAM designs and deriving four different archetypes, which illustrate very diverse EAM adoption approaches in different situations. Table 3 illustrates the main *points of difference* between the different archetypes.

6.1 Four EAM archetypes

The **modeling-driven (or framework-based) archetype** is the approach prescribed by most EA frameworks and the literature. This archetype, which is followed by Company C, is highly dependent on EA frameworks and reference architectures, and strictly follows framework guidelines and meta-models. In this archetype, all architectural layers and the integration between them are documented in detail. Moreover, different sets of standards cover different architectural layers and their integration. The modeling-driven archetype adopters follow EA phases step by step (i.e. the architecture vision, baseline architecture, target architecture, and implementation) in line with the enforcement procedures that in turn develop detailed functional and technical system specifications and manage their development through a well-structured portfolio management process. A central issue concerning this archetype is the control procedures to maintain, update, and keep consistency of EA documents according to changes in business and IT artifacts. This archetype has general drivers, for example, homogeneity in infrastructure and application landscape, and aligning IT investments with business strategies that lead to a long-term IT landscape and standardization. The major bottlenecks within this archetype are EAM document complexity, difficulty in project portfolio management and prioritization, and maintaining and updating a large bundle of EAM artifacts.

The **strategic information systems (SIS)** adopters (e.g. Company B) start from an architecture vision which defines their strategic business software (e.g. ERP). Their EAM design is largely dependent on the methodology of its SIS vendor (e.g. SAP). This archetype mostly applies to companies with centralized IT governance that seek to deploy an integrated system. Regarding EA phases, in the baseline architecture, different architectural layers are modeled only to select/evaluate the best software solution, as well as to prepare required inputs for the software implementation plan. The target architecture and implementation are mainly based on the SIS architecture as the core platform throughout the company. Since the followers place emphasis on shared business process architecture, the use of reference models in this architectural layer is very common. The governance procedures concern the implementation and maintenance of the core application as well as the development of infrastructure standards to support SIS functionalities. The shared business processes and standardization shape the main drivers for adopting this archetype, which seeks to develop an integrated system. Some of the expected bottlenecks of this archetype are total top management support, experience in implementing the given SIS, and change management.

The **governance archetype** is usually adopted by large organizations with many architecture stakeholders (e.g. Company A). The decentralized-but-federated IT governance approach, to standardize IT applications, is the main characteristic of adopters of this archetype. Due to organizational complexity, models and documents are developed on the abstract level and reference methods (i.e. EA frameworks, reference architectures, and vendor methodology) are not applicable. The EA documentation in this archetype only implies a core business process and applications on the abstract level in both the baseline architecture and the target architecture. The primary objective of the baseline architecture is to gather demands from stakeholders and identify redundancies. In the target architecture, application and technical standards are defined with the goal of developing reusable and consistent applications throughout the organization – organized in the implementation phase. In this archetype, the governance procedure concerns developing a set of standards and embedding approval processes in order to strictly follow these standards in all IT projects. The standardization in a large organization is the main driver of this archetype. The primary bottlenecks are the time-consuming process of standardization, mainly owing to the resistance to change and the unfeasibility of strict standardization in very large companies.

In the **architecture paradigm archetype**, adopters concentrate on an architecture paradigm which influences all dimensions of the EAM design. For example, Company D follows the SOA paradigm, which affects all the EA phases (from architecture vision to implementation) according to the way in which the architecture vision is organized. The target architecture is documented based on domain and service models suggested by SOA methodologies and reference models. Also, governance procedures seek to develop and manage a set of SOA standards throughout the organization. In other words, this company decided to transform EA into an SOA paradigm to create a synergic relationship between EA and SOA. The drivers of this archetype relate to the selected architecture paradigm. In our SOA case, the main driver was IT application reusability in a company with plenty of interconnected applications. The main bottlenecks in this archetype are resistance to change and significant investment at the outset.

Dimensions	Governance	Strategic IS	Modeling-driven	Architecture paradigm
EA governance	▪ Standards, e.g. application and infrastructure standards ▪ Setting approval processes in order to enforce standards	▪ Procedures to maintain and develop core applications ▪ Infrastructure standards to meet the core application requirements	▪ Different set of standards covering different architectural layers and their integration	▪ Architecture paradigm as main principle
EA phases	▪ Documenting core business processes and applications in baseline architecture in the abstract level ▪ Developing application standards and target architecture as results of consensus-building ▪ Focusing on reusable and integrated applications in EAM implementation	▪ Selecting a core application as an architecture vision ▪ Developing target architecture based on the vendor's business reference architecture and implementation of core application	▪ Documenting business processes and applications in baseline architecture in detail ▪ Defining functional and technical specifications of applications in target architecture in detail	▪ Converting current processes and applications to new architecture paradigm in target architecture ▪ Implementation based on the adopted paradigm
EA model and documentation	All architectural layers in the abstract level	Different approaches and tools for target architecture, depending on vendor's methodology	All architectural layers in detail	▪ Concentrate on domain and system architecture ▪ Modeling and tools reflecting the paradigm
Reference methods	Not applicable	▪ Highly dependent on vendor's methodology ▪ Focus on business reference model	▪ Highly dependent on EA framework and meta-model ▪ Different set of reference models are applicable	Reference architectures reflecting the paradigm, e.g. service reference architecture
Drivers	Standardization and harmonization	Deploying an integrated system throughout the organization	Aligning IT investments with business strategies	Based on architecture paradigm's main benefits, e.g. reusability in SOA paradigm

Table 3. Differentiation points of EAM archetypes

6.2 Which archetypes in which situations?

Given the characteristics of our case sample, we were unable to assess the effects of *size* and *IT penetration* on EAM adoption. From our case analysis, we identify two salient contingency factors influencing the EAM archetype: *type of business / industry* (i.e. manufacturing and service) as well as *IT management structure* (i.e. centralized and federated); the latter is a function of *organizational structure*. According to our analysis, manufacturing companies with centralized IT management (Company B) best fit the strategic information systems archetype. In a manufacturing company with federated IT management, the most opportune EAM design is governance (Company A). Moreover, for service companies with centralized IT management, the architecture paradigm is the appropriate EAM archetype (Company D). Finally, the modeling-driven archetype is most suitable for service companies that shape their IT organization to federate IT decisions (Company C).

7 Conclusion

This paper seeks to broaden the knowledge on EAM adoption by developping an analysis framework that contains exhaustive dimensions for analyzing EAM designs and considering context-dependent EAM adoption. It introduces the notion of EAM designs to describe the institutionalization of EAM in an organization based on three dimensions: 1) the explicit management of the EA life-cycle (EA phases); 2) the conceptualization and documentation of the EA in the form of models (EA model and documentation); and 3) the introduction of new governance regimes (EA governance). By using contingency theory as a theoretical lens, this paper explores different EAM designs for different institutional contingencies instead of prescribing one single development path. Our main research result is four different EAM archetypes that illustrate very diverse EAM approaches in different contingencies. Depending on the archetype, EAM initiatives will have different foci. Our study therefore relativizes the importance of EA frameworks and modeling for the success of EAM adoption, something which is at the core of the modeling-oriented archetype. It suggests three complementary approaches that emphasize governance, architecture paradigms, or core applications when adoption EAM. This study's most significant limitation concerns the typical critiques towards an exploratory research approach. While case studies provide a good entry point for understanding complex phenomena in their real-world settings, further empirical validation of results is necessary. Second, we developed an exhaustive list of contingency factors, but had to disregard some of them due to a lack of observations. As another limitation, one could argue that the explored archetypes in this taxonomy are not mutually exclusive. For example, the adopter of the governance archetype could also make use of the modeling-driven archetype in its subsidiaries. In effect, this argument stems from confusing the similarities between different archetypes as a significant overlap between them. An implication for practice is that companies should select a proper EAM adoption approach and be aware of its constitutive dimensions, expected outcomes, and probable bottlenecks. Based on our results, a company can identify a suitable EAM adoption approach that fits its contingencies. Moreover, our study offers starting points for prescriptive EAM research that support the different EAM archetypes. Future research could further uncover each archetype's characteristics by examining a wide range of organizations.

8 References

Aier, S., Gleichauf, B. & Winter, R. (2011) Understanding Enterprise Architecture Management Design – An Empirical Analysis. *Wirtschaftinformatik Proceedings 2011*.

Armour, F.J., Kaisler, S.H. & Liu, S.Y. (1999) Building an enterprise architecture step by step. *IT Professional*, 1 (4), pp.31-39.

Boh, W.F. & Yellin, D. (2006) Using Enterprise Architecture Standards in Managing Information Technology. *Journal of Management Information Systems*, 23 (3), pp.163-207.

Brown, C.V. & Magill, S.L. (1994) Alignment of the IS Functions with the Enterprise: Toward a Model of Antecedents. *MIS Quarterly*, 18 (4), p.371.

Buckl, S., Ernst, A., Lankes, J., Schneider, K. & Schweda, C. (2007) A Pattern based Approach for constructing Enterprise Architecture Management Information Models. *Internationale Tagung Wirtschaftsinformatik 2007 - Band 2*, pp.145-162.

Buckl, S., Franke, U., Holschke, O., Matthes, Florian, Schweda, C., Sommestad, T. & Ullberg, J. (2009) A Pattern-based Approach to Quantitative Enterprise Architecture Analysis. *AMCIS 2009 Proceedings*.

Buckl, S., Schweda, C.M. & Matthes, F. (2010) A Design Theory Nexus for Situational Enterprise Architecture Management. In: *Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2010 14th IEEE International*. IEEE, pp.3-8.

Eisenhardt, K.M., (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), pp.532-550.

Ernst, A. M. (2008) Enterprise architecture management patterns. In: *Proceedings of the 15th Conference on Pattern Languages of Programs*. PLoP '08. Nashville, Tennessee, ACM, pp.7:1–7:20.

Fiedler, K.D., Grover, V. & Teng, J.T.C. (1996) An Empirically Derived Taxonomy of Information Technology Structure and Its Relationship to Organizational Structure. *Journal of Management Information Systems*, 13 (1), pp.9-34.

Fielder, F. (2005) Contingency Theory of Leadership. In: *Organizational behavior: Essential theories of motivation and leadership*. Sharpe.

Fischer, R., Aier, S. & Winter, R. (2007) A Federated Approach to Enterprise Architecture Model Maintenance. *Enterprise Modelling and Information Systems Architectures*, 2 (2), pp.14–22.

Hersey, P., Blanchard, K.H. & Johnson, D.E. (2008) *Management of Organizational Behavior: Leading Human Resources*. Pearson Prentice Hall.

Hjort-Madsen, K. (2007) Institutional patterns of enterprise architecture adoption in government. *Transforming Government: People, Process and Policy*, 1 (4), pp.333-349.

Iyer, B. & Gottlieb, R. (2004) The Four-Domain Architecture: An approach to support enterprise architecture design. *IBM Systems Journal*, 43 (3), pp.587-597.

Jonkers, H., Lankhorst, M.M., ter Doest, H.W.L., Arbab, F., Bosma, H. & Wieringa, R.J. (2006) Enterprise architecture: Management tool and blueprint for the organisation. *Information Systems Frontiers*, 8 (2), pp.63-66.

Kappelman, L., McGinns, T., Pettit, A. & Sidorova, A. (2008) Enterprise Architecture: Charting the Territory for Academic Research. In: *AMCIS 2008 Proceedings*.

Lange, M. & Mendling, J. (2011) An Experts' Perspective on Enterprise Architecture Goals, Framework Adoption and Benefit Assessment. In: *Enterprise Distributed Object Computing Conference Workshops (EDOCW), 2011 15th IEEE International*. IEEE, pp.304-313.

Langenberg, K. & Wegmann, A. (2004) Enterprise Architecture: What Aspects is Current Research Targeting? (EPFL Technical Report IC/2004/77).

Leppänen, M., Valtonen, K. & Pulkkinen, M (2007) Towards a Contingency Framework for Engineering an Enterprise Architecture Planning Method. In: *Proceedings of the 30th Conference, August 11-14 of IRIS*. Tampere, Finland.

Morganwalp, J.M. & Sage, A.P. (2004) Enterprise architecture measures of effectiveness. *International Journal of Technology, Policy and Management*, 4 (1), pp.81 - 94.

Niemi, E. (2007) Enterprise Architecture Stakeholders - a Holistic View. *AMCIS 2007 Proceedings*.

Open Group, (2009). TOGAF Version 9, Available at: http://www.opengroup.org/togaf/, Accessed 29 May 2009

Premkumar, G. & King, W.R. (1994) Organizational Characteristics and Information Systems Planning: An Empirical Study. *Information Systems Research*, 5 (2), pp.75 -109.

Pulkkinen, Mirja (2006) Systemic Management of Architectural Decisions in Enterprise Architecture Planning. Four Dimensions and Three Abstraction Levels. In: *Hawaii International Conference on System Sciences*. Los Alamitos, CA, USA, IEEE Computer Society, p.179a.

Radeke, F. (2010) Awaiting Explanation in the Field of Enterprise Architecture Management. In: *AMCIS 2010 Proceedings*

Radeke, F. (2011) Toward Understanding Enterprise Architecture Management's Role in Strategic Change: Antecedents, Processes, Outcomes. *Wirtschaftinformatik Proceedings 2011*.

Riege, C. & Aier, S. (2009) A Contingency Approach to Enterprise Architecture Method Engineering. In: G. Feuerlicht & W. Lamersdorf eds. *Service-Oriented Computing – ICSOC 2008 Workshops*. Berlin, Heidelberg, Springer Berlin Heidelberg, pp.388-399.

Roeleven, S. & Broer, J. (2009) Why Two Third of Enterprise Architecture Projects Fail. *Software AG / ID Scheer*.

Sabherwal, R. & King, W.R. (1995) An Empirical Taxonomy of the Decision-Making Processes concerning Strategic Applications of Information Systems. *Journal of Management Information Systems*, 11 (4), pp.177-214.

Sabherwal, R. & King, W.R. (1992) Decision Processes for Developing Strategic Applications of Information Systems: A Contingency Approach. *Decision Sciences*, 23 (4), pp.917-943.

Sambamurthy, V. & Zmud, R.W. (1999) Arrangements for Information Technology Governance: A Theory of Multiple Contingencies. *MIS Quarterly*, 23 (2), pp.261-290.

Schekkerman, J. (2006) *How to survive in the jungle of enterprise architecture frameworks: creating or choosing an enterprise architecture framework*. Trafford Publishing.

Schmidt, C. & Buxmann, P. (2010) Outcomes and success factors of enterprise IT architecture management: empirical insight from the international financial services industry. *European Journal of Information Systems*, 20, pp.168-185.

Schöenherr, M. (2009) Towards a Common Terminology in the Discipline of Enterprise Architecture. In: G. Feuerlicht & W. Lamersdorf eds. *Service-Oriented Computing – ICSOC 2008 Workshops*. Berlin, Heidelberg, Springer Berlin Heidelberg, pp.400-413.

Schulman, J. (2004) *Patterns Play an Essential Role in EnterpriseArchitecture*. Gartner.

Stelzer, D. (2010) Enterprise Architecture Principles: Literature Review and Research Directions. In: A. Dan, F. Gittler, & F. Toumani eds. *Service-Oriented Computing. ICSOC/ServiceWave 2009 Workshops*. Berlin, Heidelberg, Springer Berlin Heidelberg, pp.12-21.

Teo, T.S.. & King, W.R. (1997) Integration between Business Planning and Information Systems Planning: An Evolutionary-Contingency Perspective. *Journal of Management Information Systems*, 14 (1), pp.185-214.

Venkatesh, V., Bala, H., Venkatraman, S. & Bates, J. (2007) Enterprise Architecture Maturity- The Story of the Veterans Health Administ ration. *MIS Quarterly Executive*, 6 (2), pp.79-90.

Vroom, V.H. & Jago, A.G. (1988) *The New Leadership: Managing Participation in Organizations*. 1st ed. Prentice Hall.

Wegmann, A., Regev, G., Rychkova, I., Lam-Son Le, de la Cruz, J.D. & Julia, P. (2007) Business and IT Alignment with SEAM for Enterprise Architecture. In: *Enterprise Distributed Object Computing Conference, 2007. EDOC 2007.* IEEE, pp.111-111.

Weill, P. & Margrethe, H.O. (1989) An Assessment of the Contingency Theory of Management Information Systems. *Journal of Management Information Systems*, 6 (1), pp.59-85.

Winter, R. (2011) Design Solution Analysis for the Construction of Situational Design Methods. In: J. Ralyté, I. Mirbel, & R. Deneckère eds. *Engineering Methods in the Service-Oriented Context*. Berlin, Heidelberg, Springer Berlin Heidelberg, pp.19-33.

Winter, R. & Fischer, R. (2006) Essential Layers, Artifacts, and Dependencies of Enterprise Architecture. In: *Enterprise Distributed Object Computing Conference Workshops, IEEE International*. Los Alamitos, CA, USA, IEEE Computer Society, p.30.

Winter, R. & Schelp, J. (2008) Enterprise architecture governance:the need for a business-to-IT approach. In: *Proceedings of the 2008 ACM symposium on Applied computing - SAC '08*. Fortaleza, Ceara, Brazil, p.548.

Yin, R. (2003) *Case Study Research: Design and Methods, Third Edition, Applied Social Research Methods Series, Vol 5*. Sage Publications.